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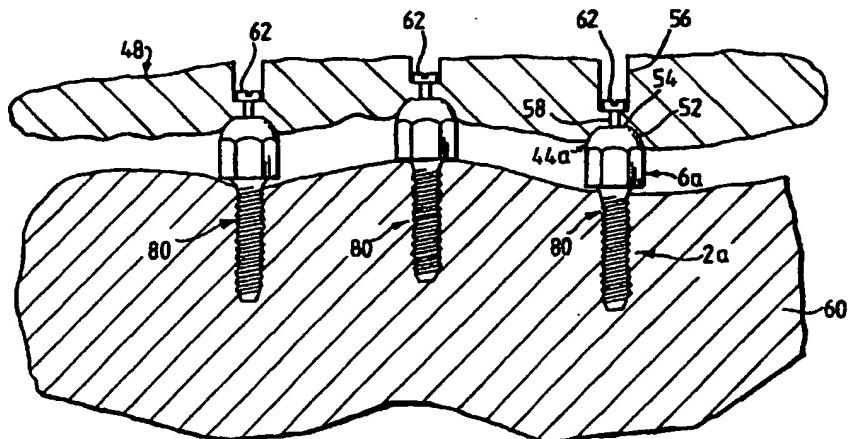
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(71) Applicant (for all designated States except US):	LEEDS PRECISION COMPONENTS LIMITED [GB/GB]; Princess Works, New Princess Street, Leeds LS11 9BA (GB).		
(72) Inventor; and			
(75) Inventor/Applicant (for US only):	EMMANUEL, Elmo, Mohan [GB/GB]; Greystones, Linton Common, Linton, West Yorkshire LS22 4JD (GB).		
(74) Agents:	BRIERLEY, Anthony, Paul et al.; Appleyard Lees, 15 Clare Road, Halifax, West Yorks HX1 2HY (GB).		

(54) Title: TOOTH SECUREMENT



(57) Abstract

A device for securing one or a plurality of teeth to the alveolar bone (60) of a patient is disclosed. The device includes osseointegratable parts (80), each of which has a screw-threaded fixture part (2a), an intermediate part (6a) and a head part (44a) which is generally dome-shaped. A bridge (48) which may support one or a plurality of teeth is arranged to co-operate with the osseointegratable part (80) by means of dimples (52) in the bridge engaging respective head parts (44a), the bridge being secured in position by respective screws (62). As an alternative to a one-piece osseointegratable part (80), an osseointegratable part which comprises three components is also described. A method of securing one or a plurality of teeth to the alveolar bone, a method of cosmetic treatment and a method of manufacturing parts of the device are also described.

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TOOTH SECUREMENT

This invention relates to the securement of one or a plurality of teeth and particularly, although not 5 exclusively, to the securement of one or a plurality of teeth by means of an implant osseointegrated into the alveolar bone of a patient.

It is well known to secure one or a plurality of 10 teeth by means of an implant osseointegrated into the alveolar bone of a patient. One commercially available system, known as the Branemark System (Trade Mark), is shown in Figure 1 of the accompanying diagrammatic drawings. Referring to Figure 1, the system includes a 15 titanium fixture 2 which is externally screw-threaded and which includes an inner channel 4 which is also screw-threaded. The fixture 2 is positioned within a threaded bore, formed in the alveolar bone, and allowed to osseointegrate over a period of about six months. In due 20 course, an abutment sleeve 6 is positioned on the fixture 2 and secured thereon by means of an abutment screw 8. The abutment sleeve 6 extends through the mucosa above the alveolar bone and an upper part of the abutment screw 8 extends therefrom. The abutment screw 8 includes a tapered 25 neck portion 10 which is arranged to provide a position of location for a correspondingly tapered portion of a gold cylinder 12. When assembled in a patient's mouth, an impression of the arrangement is taken and subsequently a prosthesis 13 which includes a gold framework 14 arranged 30 to co-operate with the gold cylinder 12 and which carries an acrylic tooth 16 is made.

The prosthesis 13 may be positioned by locating the gold cylinder 12 and gold framework 14 upon the neck 35 portion 10 of the abutment screw 8, and then securing the

- 2 -

framework in position using a gold screw 20 which is received in internally threaded bore 22 of the abutment screw 8.

5 A problem associated with the use of the Branemark System as described above is that of the precise location of the tapered portion of the gold cylinder 12 (and tooth 16) with the tapered portion of the abutment screw 8, in order to ensure that any load upon the tooth 16, for
10 example, during mastication, is equally distributed. This problem is particularly acute when a plurality of abutment screws 8 are located at spaced apart positions in the alveolar bone of a patient and wherein gold cylinders 12 are provided for co-operation with a single framework,
15 carrying a plurality of teeth, and being arranged to extend between the abutment screws 8. It has been found in practice that, in many instances, there is an unequal distribution of loads on the abutment screws 8, leading to undue stresses upon specific regions of alveolar bone and
20 also the loosening of the prosthesis. It is also noted that the use of components made of gold in the system described add significantly to the cost of such dental implants.

25 Dental implant devices have been proposed with a view to equally distributing loads upon the implant and providing an implant of lower cost. For example, U.S. Patent No. 4767328 (Branemark) discloses a device for securing a plurality of teeth, comprising components 2, 4,
30 6, 8 and 10 described above. The device further includes a prefabricated rigid splint having an arc shape to fit the curve of the alveolar bone, and being attachable to a plurality of spaced apart abutment screws 8. An assembly comprising a plurality of false teeth is removably attached to the splint and the splint is arranged to

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function as a force distribution means during use. Optionally, a resilient member may be positioned between the assembly comprising the false teeth and the splint in order to further distribute the load. Nonetheless, with 5 the device, it is still necessary to very precisely fabricate the splint for co-operation with the tapered portions of the abutment screws 8.

More recently, U.S. Patent No. 5 057 017 (Sillard) 10 has proposed a fixed removable dental implant system which includes components 2, 4, 6, 8 and 10 as described above and a precision cast bar securable to a plurality of abutment screws 8 by means of alloy screws. The construction of the precision cast support bar is 15 accomplished using an impression of the patient's mouth from which a mould is made. The precision cast support structure is cast in a vacuum so as to reduce flaws thereof. Again, however, it is necessary to very precisely fabricate the support bar for co-operation with the 20 tapered portions of the abutment screws 8.

It is an object of the present invention to alleviate some of the problems associated with known teeth 25 securing systems.

According to a first aspect of the present invention, there is provided a device for securing one or a plurality of teeth to the alveolar bone, the device comprising first 30 securing means securable to the alveolar bone such that a first axis of the first securing means is substantially upright, an outer part of the first securing means including a curved surface which curves towards said first axis, the device further comprising a tooth securing member which is co-operable with said

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outer part for securing one or a plurality of teeth to the alveolar bone.

The device of the present invention may provide
5 advantages over the device used in the Branemark system described above, since that system relies on the passive fit of tapering surfaces which surfaces are circumferentially disposed about an elongate axis of the device.

10

Said first securement means of said first aspect is preferably arranged to be screwed into the alveolar bone. To this end, said first securement means suitably includes a screw-threaded region at or towards an inner end thereof. The screw-threads of said screw-threaded region are preferably arranged about said first axis; that is, the rotational axis of said screw-threaded region is preferably coincident with said first axis. The first securement means is preferably arranged to become
15 osseointegrated into the alveolar bone. To this end, said first securement means is preferably made of titanium, at least in a region thereof which is positioned in use within the alveolar bone. The whole of said first securement means may be made of titanium.
20

25

Said first securement means preferably includes a mucosal part which is arranged to extend through the mucosa above the alveolar bone. Said outer part of the first securement means is preferably arranged to extend
30 above the mucosa.

Said outer part of said first securement means is preferably symmetrically arranged about said first axis. The outer part may include a single continuous curved surface or may include a plurality of spaced apart curved
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surfaces. Preferably, said outer part includes a continuous curved surface which extends circumferentially about said first axis. Said curved surface is preferably partially spherical, with the centre of the sphere 5 preferably being disposed on said first axis. Said curved surface is preferably substantially hemispherical. The outer part may include a substantially planar region which is preferably circular in cross-section and which is preferably axially aligned with said first axis. Said substantially planar region may interrupt, in part, the curved surface of the outer part. For example, where the curved surface is partially spherical, for example, substantially hemispherical, said substantially planar region may interrupt the spherical surface.

15

Preferably, the curved surface of said outer part is a convex surface.

In a preferred embodiment, said outer part of said 20 first securement means is substantially dome-shaped. Said dome may have a parabolic, for example part-circular, cross-section. Said dome may include a substantially planar region which interrupts its outer surface. Said planar region may be as described above.

25

Said tooth securement member preferably includes a curved surface which substantially corresponds in shape to that of said curved surface of said outer part. Said tooth securement member is preferably arranged to be engaged 30 closely with said curved surface of the outer part. When the curved surface of said outer part is convex, preferably the curved surface of said tooth securement member is concave. In a preferred embodiment, said curved surface of said tooth securement member is partially 35 spherical, more preferably substantially hemispherical.

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Said device suitably includes second securement means for securing said first securement means to said tooth securement member. Said second securement means preferably includes a screw-threaded socket arranged to be engaged by
5 a screw. Preferably, said screw-threaded socket is provided in said first securement means. In this case, preferably, said screw-threaded socket is aligned with said first axis. Said screw-threaded socket preferably opens through said outer part of said first securement
10 means. Said tooth securement member is preferably arranged to co-operate with a screw engagable in said screw-threaded socket. For example, said tooth securement member preferably includes a bore arranged to receive the screw and being axially alignable with the screw-threaded socket
15 of said first securement means.

The outer part of said first securement means is preferably fixed in position relative to inner parts thereof. The curved surface of the outer part preferably
20 extends in a pre-defined, unadjustable direction relative to said first axis.

The first securement means preferably comprises a plurality of parts which are attachable to one another. In
25 a preferred embodiment, the first securement means includes a first part which is arranged to be screwed into the alveolar bone as described above and a separate second part which includes said outer part. Said first and second parts are preferably arranged to be screwed together.
30

Preferably, the first securement means comprises only three parts - said first and second parts as described above and a third part arranged to be positioned between the first and second parts.

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In another embodiment, the first securement means may comprise a single part which is arranged to be secured to the alveolar bone as described above and which includes an outer part as described above.

5

The device may include a plurality of said first securement means described above. Each of said securement means is preferably arranged to co-operate with said tooth securement member. Said tooth securement member may 10 include one or a plurality of teeth attached thereto.

Where a single first securement means is provided for co-operation with a tooth securement member, preferably means is provided for restricting rotation of the first 15 securement means relative to the tooth securement member.

According to a second aspect of the present invention, there is provided a first securement means as described in any statement herein, the first securement 20 means being securable to the alveolar bone such that a first axis of the first securement means is substantially upright, an outer part of the first securement means including a curved surface which curves towards said first axis and said outer part being arranged to co-operate with 25 a tooth securement member for securing one or a plurality of teeth to the alveolar bone.

According to a third aspect of the present invention, there is provided a securement part, for example, a 30 securement screw, for a device for securing one or a plurality of teeth to the alveolar bone as described in any statement herein, said securement part having a first axis and being arranged to co-operate with an osseointegrated part, for example, a screw-threaded socket 35 osseointegrated in the alveolar bone so that said first

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axis is substantially upright, an outer part of the securement part including a curved surface which curves towards said first axis and is arranged to co-operate with a tooth securement member for securing one or a plurality
5 of teeth to the alveolar bone.

According to a fourth aspect of the present invention, there is provided a method of securing one or a plurality of teeth to the alveolar bone, the method
10 using a device according to the first aspect and comprising securing said first securement means to the alveolar bone and securing said tooth securement member to said first securement means.

15 The invention extends to a method of cosmetic treatment using a device according to the first aspect, the method comprising securing said first securement means to the alveolar bone and securing said tooth securement member to said first securement means.

20 The invention further extends to a method of manufacturing a tooth securement member for co-operation with first securement means as described herein, the method comprising assessing the characteristics and/or
25 position of said first securement means when secured to the alveolar bone and using said assessment to control the production, for example, by machining, of the tooth securement member from a blank, for example, a wrought blank of, for example, titanium or cobalt chrome.

30 Specific embodiments of the present invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

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Figure 1 is an exploded view showing components of the Branemark System (Trade Mark) described above;

5 Figure 2 is an exploded view of components of a device of the present invention, with portions of the components being shown in cross-section;

10 Figure 3 is an underneath plan view of a bridge of

the device of the present invention; and

15 Figure 4 is a vertical cross-section through the alveolar bone of a patient showing a device of the present invention in situ.

20 Some of the components of the device of the present invention are the same or similar to those utilised in the Branemark system as described with reference to Figure 1. In the figures the same or similar parts have the same reference numerals.

25 Referring to Figure 2, there is shown a titanium fixture 2 arranged to be positioned within the alveolar bone and become osseointegrated therewith. As described above, the fixture 2 is externally screw-threaded, to aid
30 securement within the bone, and also includes an internally screw-threaded axially extending bore 20. The fixture 2 is arranged to co-operate with an abutment sleeve 6. The abutment sleeve 6 includes a radially extending annular shoulder 22, the lower surface of which is arranged to abut an upper surface 24 of the fixture 2 when the sleeve 6 is positioned thereupon. At its upper end, the sleeve 6 includes a tapering annular seat 25, wherein the angle of taper is about 45°. The tapering annular seat is arranged to provide a seat for location of
35 an abutment screw 26.

- 10 -

The abutment screw 26 includes, towards its lower end, an externally screw-threaded shaft portion 28. The shaft portion 28 is connected to a neck portion 30 which comprises a frusto-conical portion 34, a first wide diameter cylindrical portion 36, a narrow diameter cylindrical portion 38, a second wide diameter cylindrical portion 40 and a tapering portion 42. The tapering portion 42 is arranged to abut the tapering annular seat 25 of the sleeve 6, to locate the abutment screw 26 in position.

10

The annular portion 42 is connected to a dome-shaped head 44. The head 44 includes a substantially hemispherical part and a flattened region 46 which is substantially circular in plan view and is axially aligned with the hemispherical part. An internally threaded axially extending bore 49 is provided in the head 44. The head 44 is arranged to co-operate with bridge 48 (Figure 3) for securing a plurality of false teeth in position.

20

Referring to Figure 3, the bridge 48 is arcuate in shape and arranged to follow the shape of the alveolar bone 60. The bridge carries a plurality of false teeth (not shown) thereon. On its lower side, shown in the Figure, the bridge includes three spaced-apart dimples 50 each of which is arranged to co-operate with a head 44 of an abutment screw 26. Thus, the dimples include a substantially hemispherical part 52 and a flattened region 54 (Figure 4). Relatively wide cylinder-shaped bores 56, which are open to the upper side of the bridge 48, communicate with relatively narrow cylinder-shaped bores 58 which, in turn, open into the dimples 50, via the flattened region 54.

With the fixtures 2 osseointegrated in the alveolar bone 60 and the sleeves 6 and abutment screws 26 securely

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fixed in position, the bridge 48 is positioned with its dimples 52 overlying and abutting the heads 44 of the screws 26. Then, screws 62 are inserted into the bores 56 and screwed into the bores 20 in the heads 44 of the 5 abutment screws 26, so as to secure the bridge 48 in position.

In Figure 4, a one-piece osseointegratable part 80 is shown. The part 80 includes a fixture part 2a which 10 corresponds to the fixture 2 of Figure 2, an intermediate part 6a which corresponds to the abutment sleeve 6 of Figure 2 and a head part 44a which corresponds to the head 44 of the abutment screw 26. The bridge co-operates with the osseointegratable part 80 as described above and as 15 shown in Figure 4.

It should be appreciated that one or a plurality of co-operating dome-shaped heads and dimples may be provided depending upon the number of false teeth carried by a 20 bridge. A bridge may, for example, include only a single dimple when only one false tooth is to be fitted. In this case, a means is provided for restricting rotation of the head relative to the bridge.

25 The manufacture of components of the device described above and the fitment of false teeth to a patient are now described in greater detail.

Fixture 2, abutment sleeve 6 and abutment screw 26 30 are manufactured by standard techniques. In use, the fixture 2 is allowed to become osseointegrated into the alveolar bone 60 prior to the securement thereto of the sleeve 6 and the screw 26. If the one-piece osseointegratable part 80 is used, this is allowed to 35 become osseointegrated. Then, an impression is taken of

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the patient's mouth by standard techniques, so as to clearly show the arrangement of the heads 44 or 44a. From this impression, the bridge 48 is made by casting or by machining. It has been found that the bridge can
5 satisfactorily be made from titanium by the aforementioned methods. A preferred method of making the bridge involves using a probe to map out exactly the characteristics of the impression (e.g. the relative positions of the dimples), storing the characteristics in a computer and
10 then using the computer to control the machining of a wrought titanium beam according to the characteristics required. A 3 axis CNC co-ordinate measuring machine with full 3D digitising software and a PH 9 type motorised probe head is used. This is coupled to a post processor
15 which can convert the information into co-ordinates compatible with either a 3/5 axis CNC machining centre or EDM.

Once the bridge has been made, the false teeth may be
20 fixed thereto by known techniques.

Once completed, the bridge 48 may be permanently secured in position by using screws 62 as described above.

25 It has been found that the provision of bridge 48 and abutments screws 26 described herein allow securement of false teeth in an advantageous manner.

The location of the bridge 48 on the abutment screws
30 26 has been found to be more precise than in, for example, the arrangement of the Figure 1 embodiment. This may, therefore, provide a more even distribution of loads and greater comfort for a patient. Since the bridge 48 may be machined from a wrought titanium beam (rather than being
35 cast using a gold alloy) this may increase the strength

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and durability of the device for a reduced cost. As an alternative to the use of a wrought titanium beam, a cobalt chrome beam may be used.

5 As an alternative to the use of a three component stack comprising a fixture 2, sleeve 6 and abutment screw 26, or the one-piece osseointegratable part 80, a two component stack may be provided which utilises a fixture 2 as described above in combination with a second part in
10 which sleeve 6 and screw 26 are formed as a single part.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and
15 which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

20 All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.
25

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly
30 stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the
35 foregoing embodiment(s). The invention extends to any

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novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any
5 method or process so disclosed.

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CLAIMS

1. A device for securing one or a plurality of teeth to the alveolar bone, the device comprising first securement means securable to the alveolar bone such that a first axis of the first securement means is substantially upright, an outer part of the first securement means including a curved surface which curves towards said first axis, the device further comprising a tooth securement member which is co-operable with said outer part for securing one or a plurality of teeth to the alveolar bone.
5
2. A device according to Claim 1, wherein said first securement means is arranged to be screwed into the alveolar bone.
15
3. A device according to Claim 1 or Claim 2, wherein said first securement means includes a mucosal part which is arranged to extend through the mucosa above the alveolar bone.
20
4. A device according to any preceding claim, wherein said outer part of the first securement means is arranged to extend above the mucosa.
25
5. A device according to any preceding claim, wherein said outer part of said first securement means is symmetrically arranged about said first axis.
- 30 6. A device according to any preceding claim, wherein said outer part includes a continuous curved surface which extends circumferentially about said first axis.

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7. A device according to any preceding claim, wherein said curved surface is partially spherical, with the centre of the sphere being disposed on said first axis.
- 5 8. A device according to any preceding claim, wherein the curved surface of said outer part is a convex surface.
- 10 9. A device according to any preceding claim, wherein said tooth securement member includes a curved surface which substantially corresponds in shape to that of said curved surface of said outer part.
- 15 10. A device according to any preceding claim, wherein said tooth securement member includes a concave surface which co-operates with said outer part of the first securement means.
- 20 11. A device according to any preceding claim, including second securement means for securing said first securement means to said tooth securement member.
- 25 12. A device according to Claim 11, wherein said second securement means includes a screw-threaded socket arranged to be engaged by a screw.
13. A device according to Claim 12, wherein said screw-threaded socket opens through said outer part of said first securement means.
- 30 14. A device according to any preceding claim, wherein the outer part of said first securement means is fixed in position relative to inner parts thereof.
- 35 15. A device according to any preceding claim, wherein the curved surface of the outer part extends in a pre-

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defined, unadjustable direction relative to said first axis.

16. A device according to any preceding claim, including
5 a plurality of said first securement means.

17. A device according to Claim 16, wherein each of said securement means is arranged to co-operate with said tooth securement member.

10
18. A first securement means of a device for securing one or a plurality of teeth to the alveolar bone, the first securement means being securable to the alveolar bone such that a first axis of the first securement means is substantially upright, an outer part of the first securement means including a curved surface which curves towards said first axis and said outer part being arranged to co-operate with a tooth securement member for securing one or a plurality of teeth to the alveolar bone.

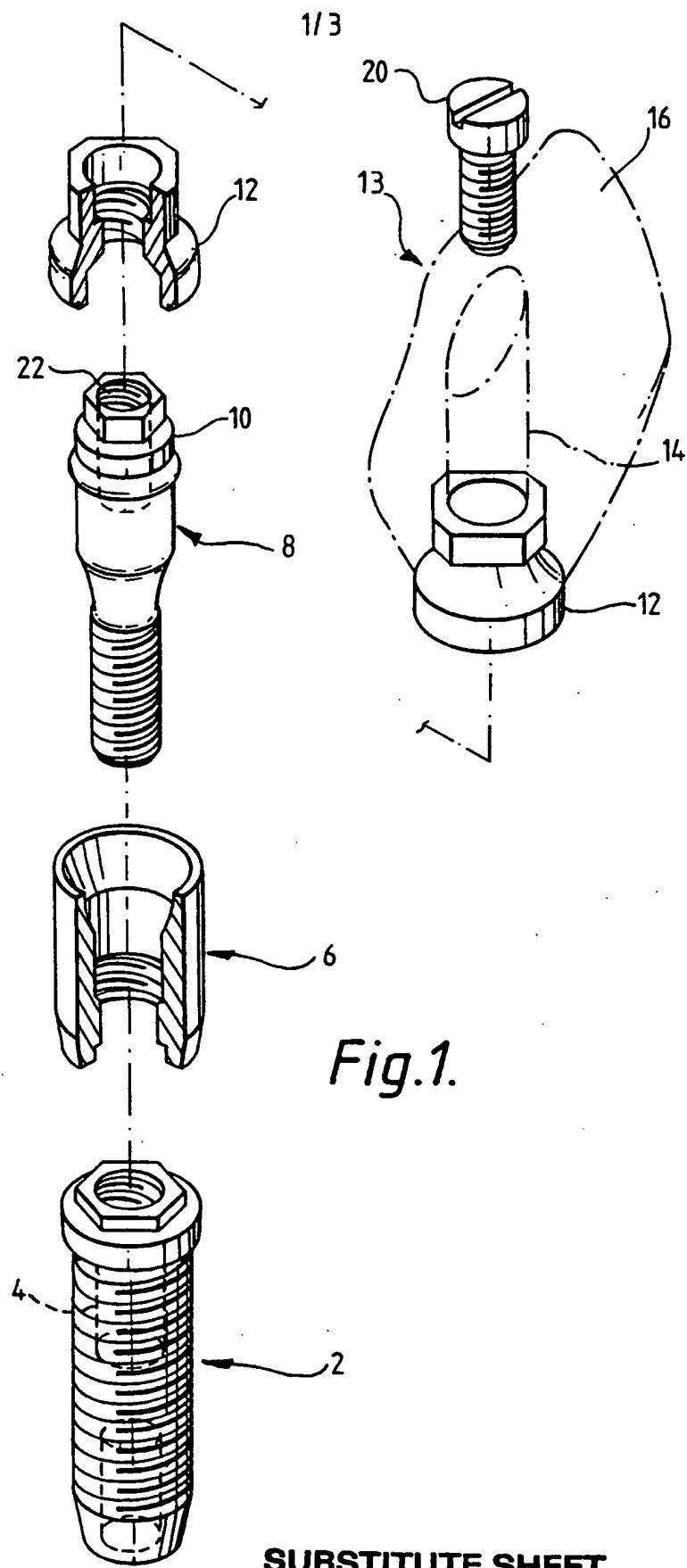
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20
19. A securement part of a device for securing one or a plurality of teeth to the alveolar bone, said securement part having a first axis and being arranged to co-operate with an osseointegrated part of the device which is osseointegrated in the alveolar bone so that, in use, said first axis is substantially upright, an outer part of the securement part including a curved surface which curves towards said first axis and is arranged to co-operate with a tooth securement member for securing one or a plurality
25
30 of teeth to the alveolar bone.

20. A method of securing one or a plurality of teeth to the alveolar bone, the method using a device according to any of Claims 1 to 17 and comprising securing said first

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securement means to the alveolar bone and securing said tooth securement member to said first securement means.

- 5 21. A method of cosmetic treatment using a device according to any of Claims 1 to 17, the method comprising securing said first securement means to the alveolar bone and securing said tooth securement member to said first securement means.
- 10 22. A method of manufacturing a tooth securement member for co-operation with a first securement means of a device according to any of Claims 1 to 17, the method comprising assessing the characteristics and/or position of said first securement means when secured to the alveolar bone
- 15 and using said assessment to control the production of the tooth securement member from a blank.



SUBSTITUTE SHEET

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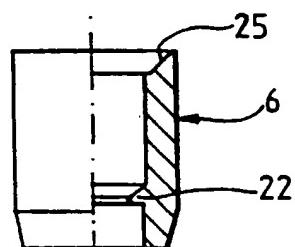
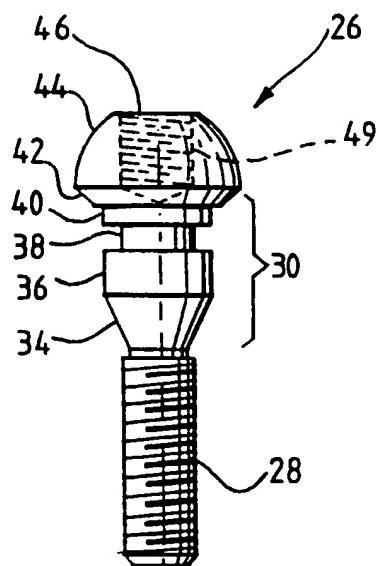
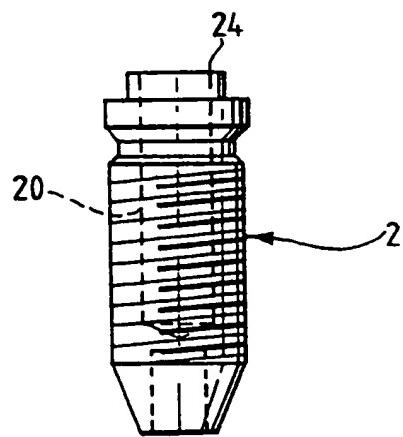
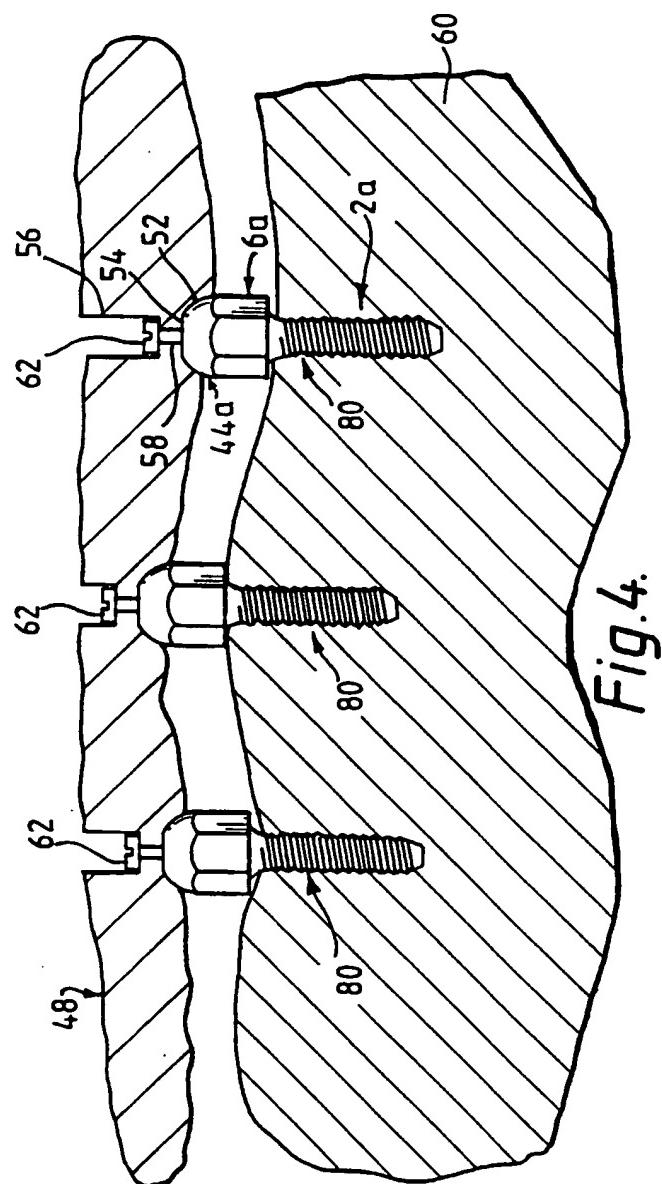
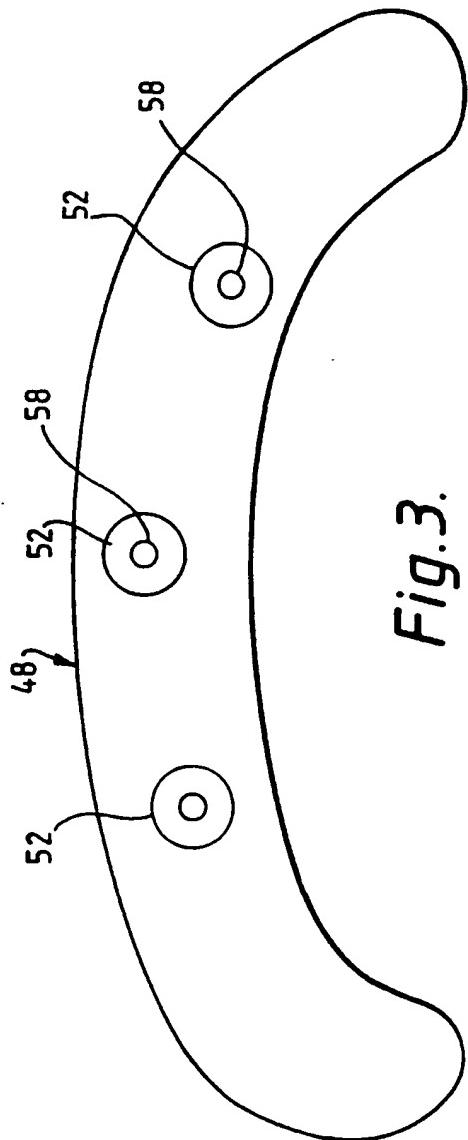


Fig. 2.

**SUBSTITUTE SHEET**

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**SUBSTITUTE SHEET**

INTERNATIONAL SEARCH REPORT

In	International Application No
PCT/GB 94/00020	

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 A61C8/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 5 A61C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT
--

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 216 031 (KIRSCH) 1 April 1987 see column 10, line 46 - line 53; figure 4 ---	1,3-19, 22
A	US,A,5 057 017 (SILLARD) 15 October 1991 cited in the application see the whole document ---	1,2
P,X	CA,A,1 313 597 (PILLIARD) 16 February 1993 see page 9, line 1 - page 10, line 33; figures 5,6 -----	1-19,22

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *I* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

2

Date of the actual completion of the international search

10 May 1994

Date of mailing of the international search report

18.05.94

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl.
Fax (+31-70) 340-3016

Authorized officer

Vanrunxt, J

INTERNATIONAL SEARCH REPORT

International application No.

PCT/GB94/00020

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.: **20 and 21**
because they relate to subject matter not required to be searched by this Authority, namely:
Please see Rule 39.1(iv) PCT.
2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
 No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 94/00020

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A-0216031	01-04-87	DE-A-	3531389	05-03-87
		AU-B-	591697	14-12-89
		AU-A-	6214186	05-03-87
		CA-A-	1272621	14-08-90
		JP-A-	62053648	09-03-87
		US-A-	4793808	27-12-88
US-A-5057017	15-10-91	US-A-	4931016	05-06-90
		CA-A-	1319035	15-06-93
CA-A-1313597	16-02-93	NONE		